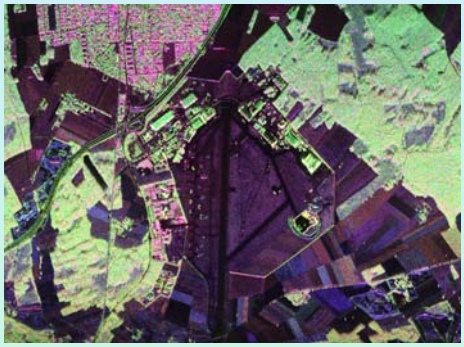
E-SAR

The Experimental airborne SAR System of DLR

Data of new quality generated by Synthetic Aperture Radar

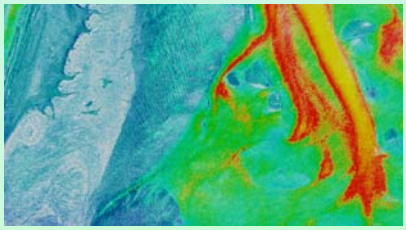
Deutsches Zentrum für Luft- und Raumfahrt e.V.

E-SAR onboard a DLR DO 228-212.

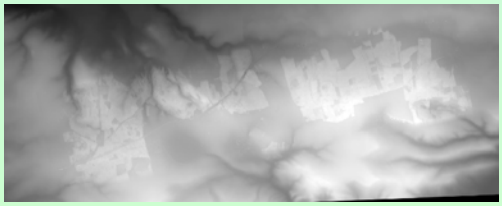


E-SAR polarimetric L-band image. The airfield of Oberpfaffenhofen and the DLR research centre left of the main runway.

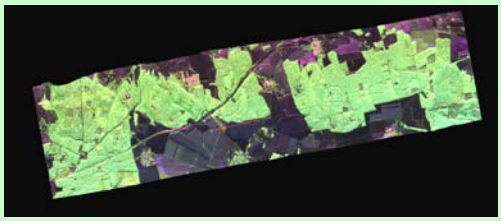
Red: Even bounce reflections.
Green: Volume scattering.
Blue: Odd bounce reflections.



E-SAR X-band-ATI result. The island of Ameland in the Dutch wadden at beginning low tide. The red and yellow coloured areas show dropping water with high tidal current velocities.



E-SAR X-band XTI DEM. Scene: Managed forest near the German city of Erfurt.



E-SAR L-band image product, geo-coded. Scene: Managed forest near the German city of Erfurt.

The E-SAR Sensor System

E-SAR is a Synthetic Aperture Radar (SAR) system onboard a DLR Dornier DO 228 aircraft. The sensor operates in 4 frequency bands, X-, C-, L- and P-band, hence it covers a range of wavelengths from 3 to 85 cm. The polarisation of the radar signal is selectable, horizontal as well as vertical. In polarimetric mode the polarisation is switched from pulse to pulse.
E-SAR offers high operational flexibility. The measurement modes include single channel operation, i.e. one wavelength and polarisation at a time, and the modes of **SAR Interferometry** and **SAR Polarimetry**.
The system is polarimetrically calibrated in L- and P-band. SAR Interferometry is operational in X-band (XTI and ATI). **Repeat Pass SAR Interferometry** is operational in L- and P-band, especially in combination with polarimetry.

A modern **RT-DGPS/INS System** (IGI CCNS4/Aerocontrol IId) combined with a FUGRO OmniStar DGPS receiver allows most precise navigation and positioning. E-SAR is hence able to generate geocoded image products of very high geographical precision. Repeat Pass SAR Interferometry at baselines of less than 10 m becomes possible.

Part of the sensor system is an operational **E-SAR ground segment**. After transcription from HDDC (SONY SD-1) to hard disk drive the E-SAR ECS-Processor converts the SAR data to calibrated image data products. To increase the product quality level to CEOS level 1 b3 radiometric and polarimetric calibration, DEM generation and geo-coding are operationally implemented.

Owner of the system is the German Aerospace Center (DLR).

System Operations is under responsibility of the Institut fuer Hochfrequenztechnik & Radarsysteme (DLR-HR) in co-operation with the DLR Research Flight Facilities (DLR-FB) in Oberpfaffenhofen, Germany.

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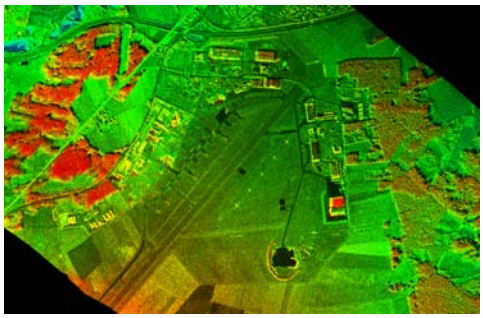
E-SAR SYSTEM PERFORMANCE	
PLATFORM	Dornier DO 228-212, modified
Aircraft-ID	D-CFFU
Engines	2 turboprop, Garrett TPE 331-5A-252D
Air crew	2 pilots, 1 a/c engineer; 3 radar operators
Oxygen installation	Max. 6 persons, up to 4 hours
Ceiling with E-SAR	20 000 ft above mean sea level (FL 200)
Range with E-SAR	600 nautical miles
Endurance with E-SAR	2.5 to 3 hours under IFR conditions
Certification	CAT 1 - IFR
RADAR SENSOR	Synthetic Aperture Radar (SAR)
Name	E-SAR
Frequency ranges	X (9.6 GHz), C (5.3 GHz), L (1.3 GHz), P (360 MHz)
Measurement modes	SAR Interferometry, SAR Polarimetry
Slant range resolution	2.3 m (HR) or 4.5 m (MR)
Azimuth resolution	0.7 m (1-lk), 2.5 m (3-lk), > 3 m (> 6-lk)
Swath width (on ground)	3 km (NS) or 5 km (WS)
Incidence angle range	Typ. 27° to 55°(NS) or 60°(WS), off-nadir
Scene size (typ.)	Up to 3 x 20 km (NS) or 5 x 20 km (WS)
Navigation	IGI CCNS4/Aerocontrol IId, (L1/L2-GPS)
PRODUCTS	
Product classes	Raw data, image data (up to level 1b3)
Calibration, radiometric	≤ 3 dB (absolute.), ≤ 1 dB (relative)
Calibration, polarimetric	Cross Talk ≤ -30 dB, Phase ≤ 10°
Raw data encoding	6 or 8 Bit, I and Q, incl. auxiliary data
Image data (simple)	Single channel, intensity, multi-look
Image data (complex)	Multi-channel, SLC and intensity, multi-look
DEM (Resolution/Posting)	5 m, 5 m, ≤ 1m (N, E, H) / 2.5 and 5 m
DEM (Accuracy)	2 m, 2 m, ≤ 4 m (N, E, H), absolute
Geo-coding	UTM WGS84 (and GK), Posting ≥ 1 m
Image data, geo-coded	Intensity channels only
Special products	Coherence, space and time
Formats	E-SAR raw and image data format, Unix TAR
Media	DVD-R, CD-R



Airfield Oberpfaffenhofen. Geo-coded E-SAR X-band product. Colour coding represents the measured topographic elevations in XTI-mode.